

LUNG IRRADIATION WITH STATIC PLUTONIUM MICROSPHERES*

E. C. Anderson, L. M. Holland, J. R. Prine, and C. R. Richmond

Los Alamos Scientific Laboratory
University of California
Los Alamos, New Mexico 87544

Hamsters are exposed to selected lung burdens of plutonium contained in 10- μ m diameter inert microspheres of ZrO_2 ceramic. Injected into the jugular vein, the microspheres lodge quantitatively in the lung capillaries and remain immobile for the life of the hamster. Distribution through the lung is essentially random but shows a systematic variation through a factor of about two from lobe to lobe.

The specific activity of the microspheres is varied from 0.01-100 pCi per sphere, spanning the range of respirable particles of $^{238}PuO_2$ and $^{239}PuO_2$. The number of spheres per animal varies from 2000-1,000,000 and the lung burden from 0.1-1000 nCi. The fraction of lung irradiated ranges from 0.01-0.98, and the calculated median dose rate to the tissue exposed is from 0.5-700 krad per year. The spheres are completely inert and provoke no foreign-body reactions. In contrast to most methods of exposure by inhalation or insufflation, the radiation is delivered essentially 100% to the lung. Because of the immobility and uniformity of the microspheres, the distribution of energy deposition can be calculated with precision on a microscale.

The most surprising result has been the minimal biological damage even after exposure times in excess of two years. Not only are gross effects (such as pneumonitis, hyperplasia, fibrosis, and tumors) insignificant, but little or no deterioration of parenchymal microstructure has been observed.

*This work is being performed under the auspices of the U. S. Atomic Energy Commission.